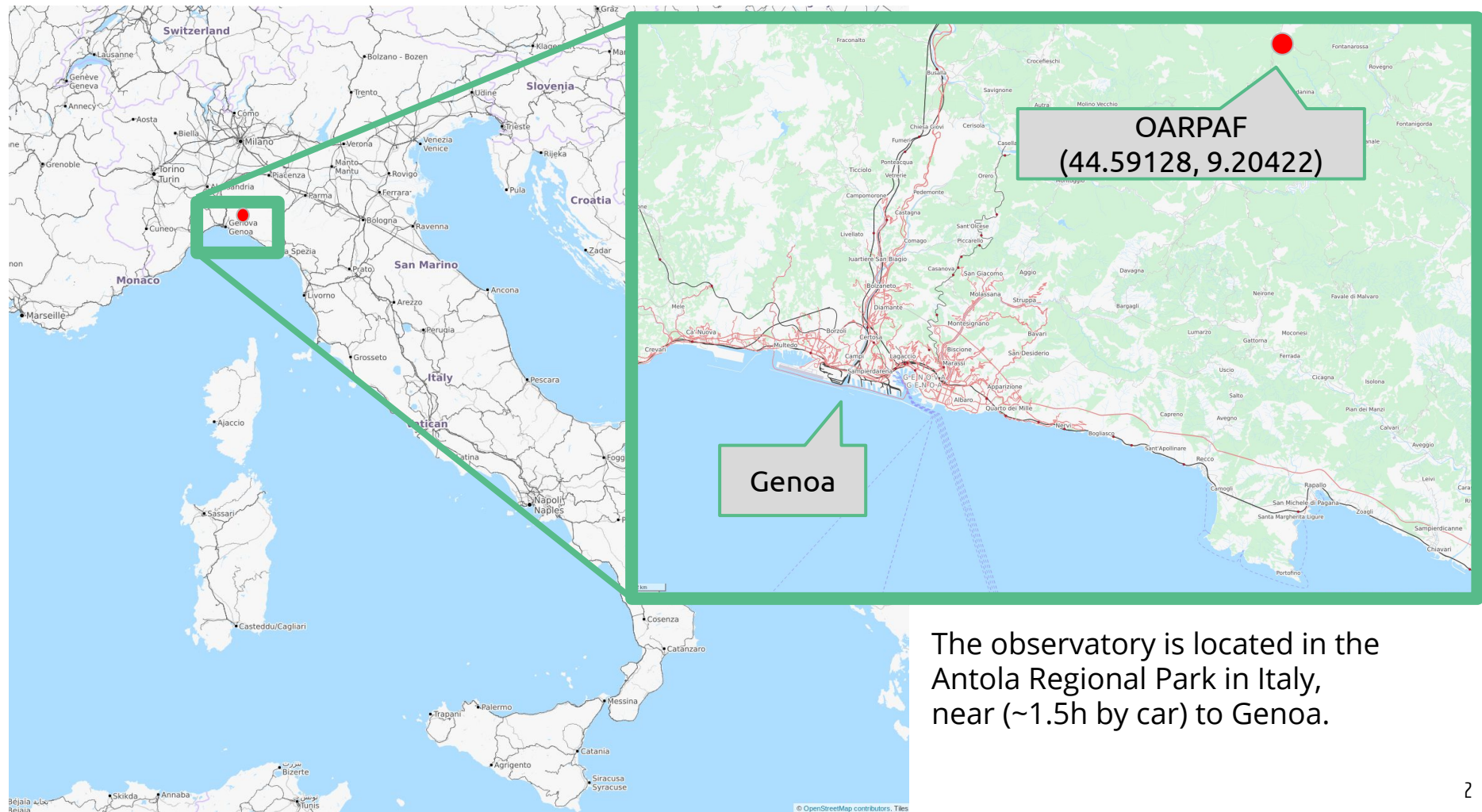




# Cerberus: A three-headed instrument for the OARPAF telescope.

106° congresso nazionale SIF  
2020-09-14 - Sezione III

Davide Ricci - Lorenzo Cabona - Andrea La Camera - Silvano Tosi - Chiara Righi



The observatory is located in the Antola Regional Park in Italy, near (~1.5h by car) to Genoa.



OSSERVATORIO  
ASTRONOMICO  
REGIONALE  
PARCO ANTOLA  
COMUNE DI FASCIA





# The Telescope

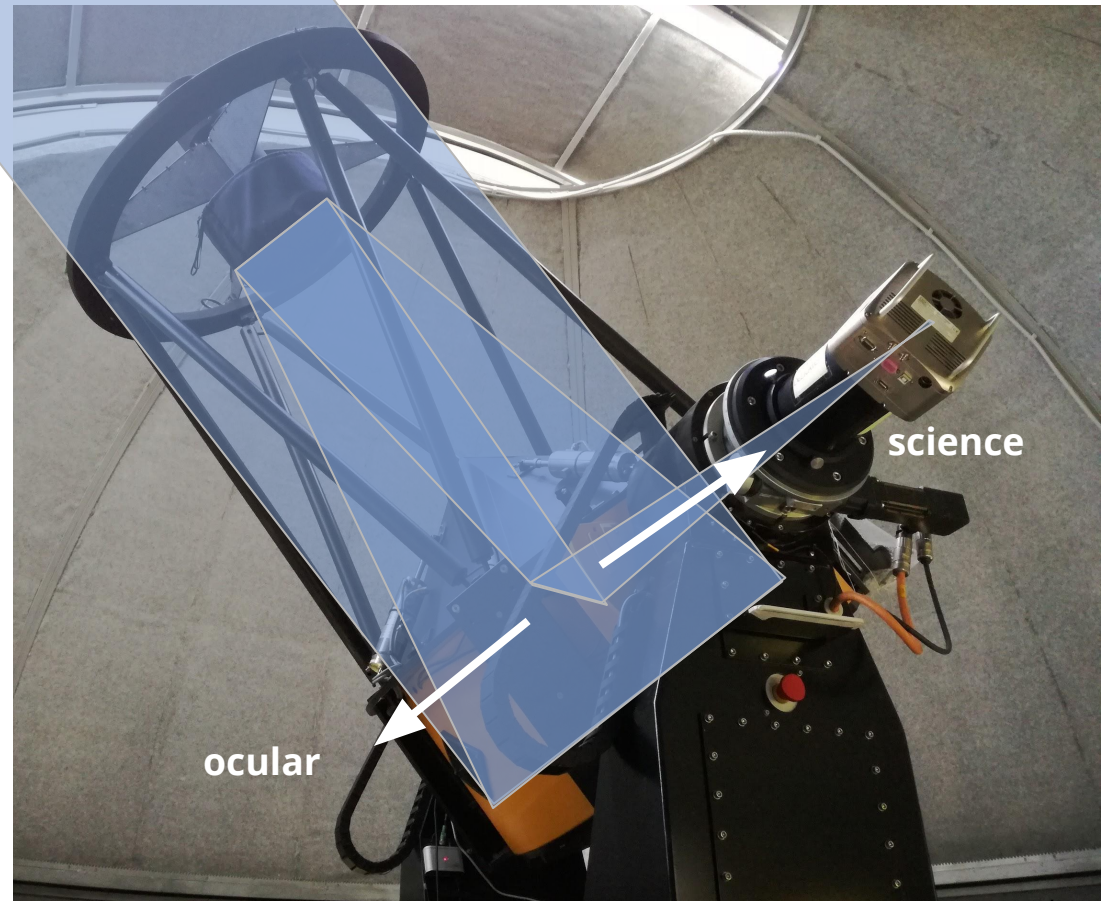
The OARPAF telescope is a Cassegrain-Nashmyth type 80cm wide.

It has an alt-azimuth mount.

It was designed by the Astelco company to foresee a double Nasmyth focal station:

the first, provided with a field derotator, is dedicated to scientific observations;

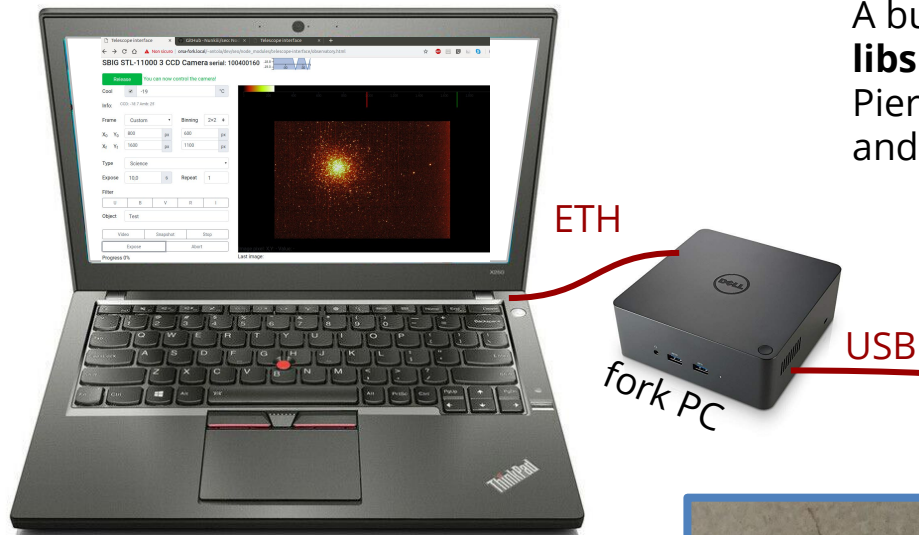
the second is dedicated to ocular observations by amateurs.



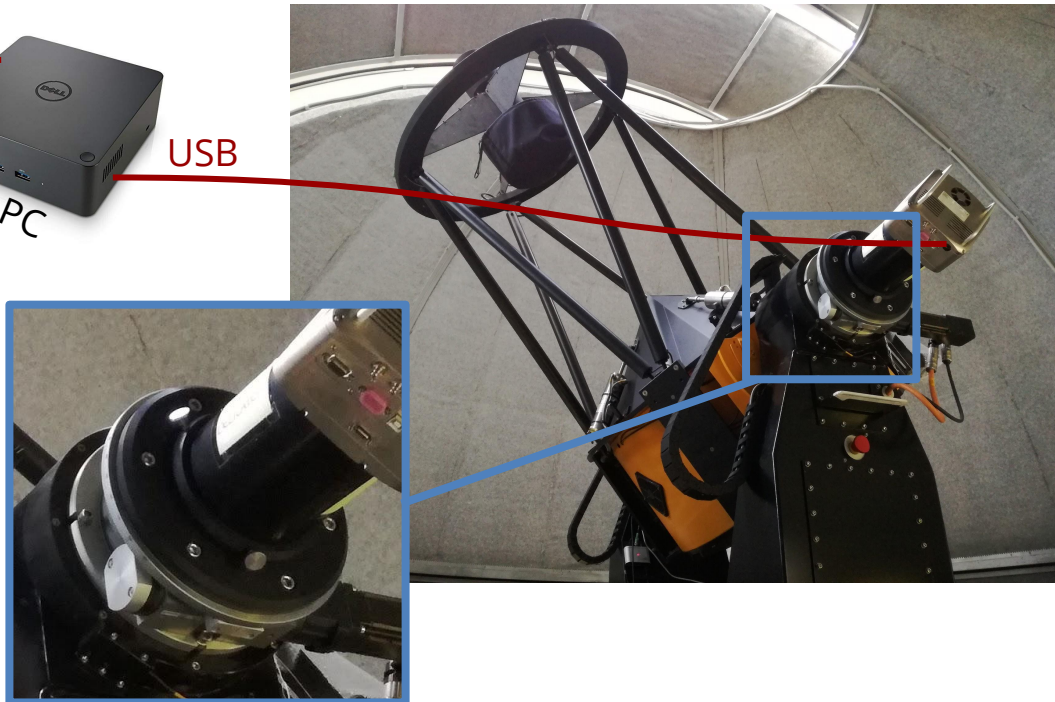
# Instrument in use

The instrument in use is a SBIG STL 11000 CCD:  
37×25mm, 4008×2672px (9μm), controlled via USB.

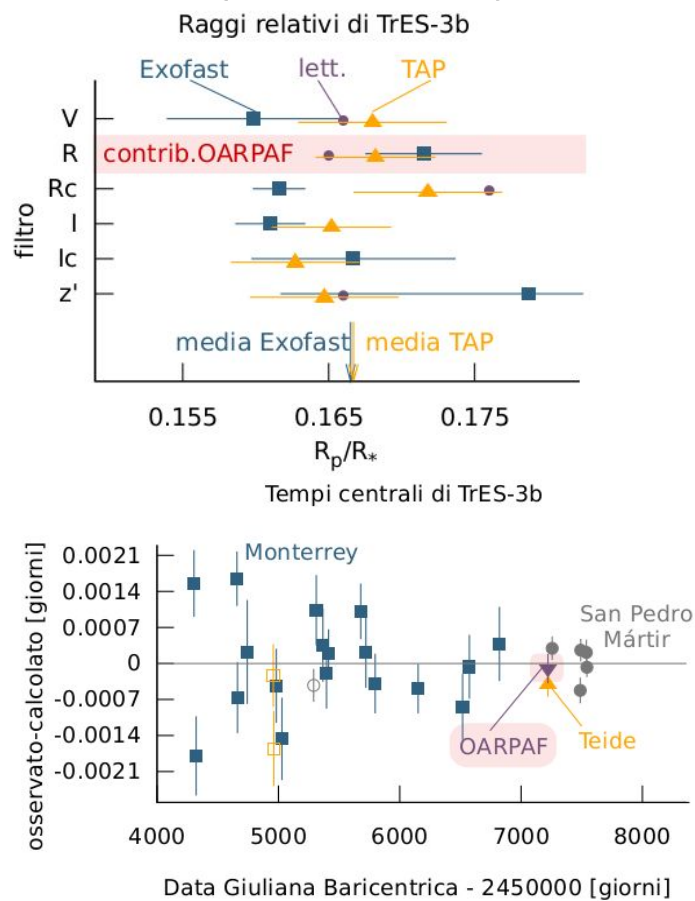
A buffer PC in the fork mount has installed the **libsbigudrv** library and a **node.js** software developed by Pierre Sprimont and Davide Ricci, allowing a connection and control via local network using a **web browser**.



...up to now!

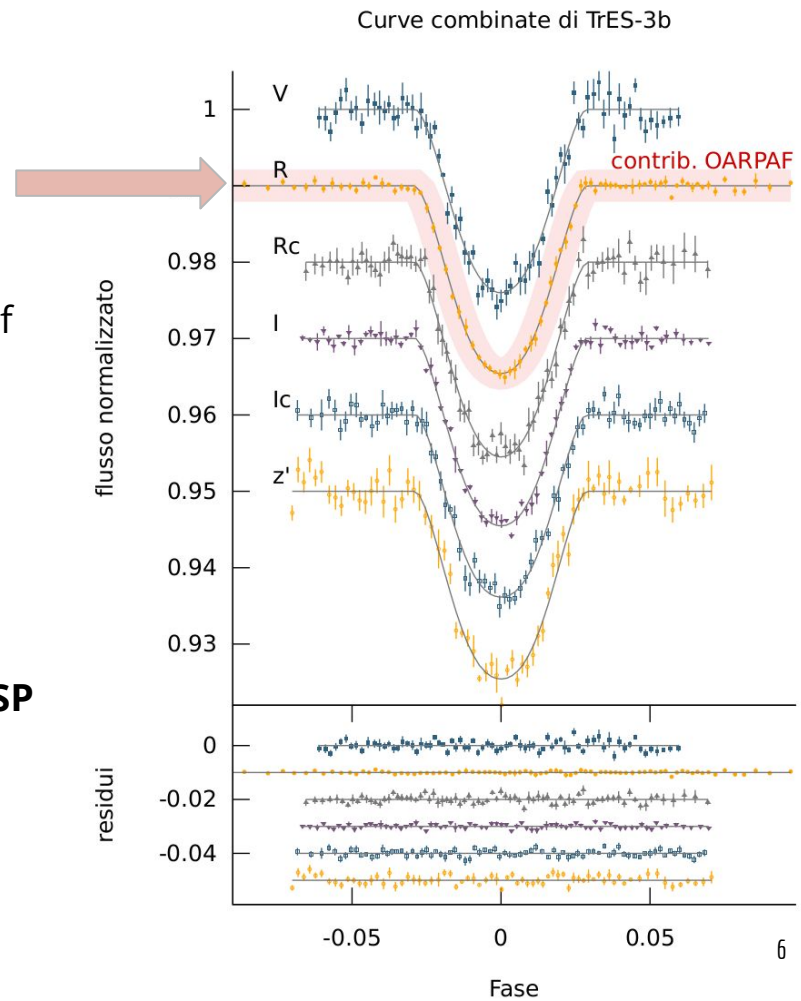


# Exoplanetary transits



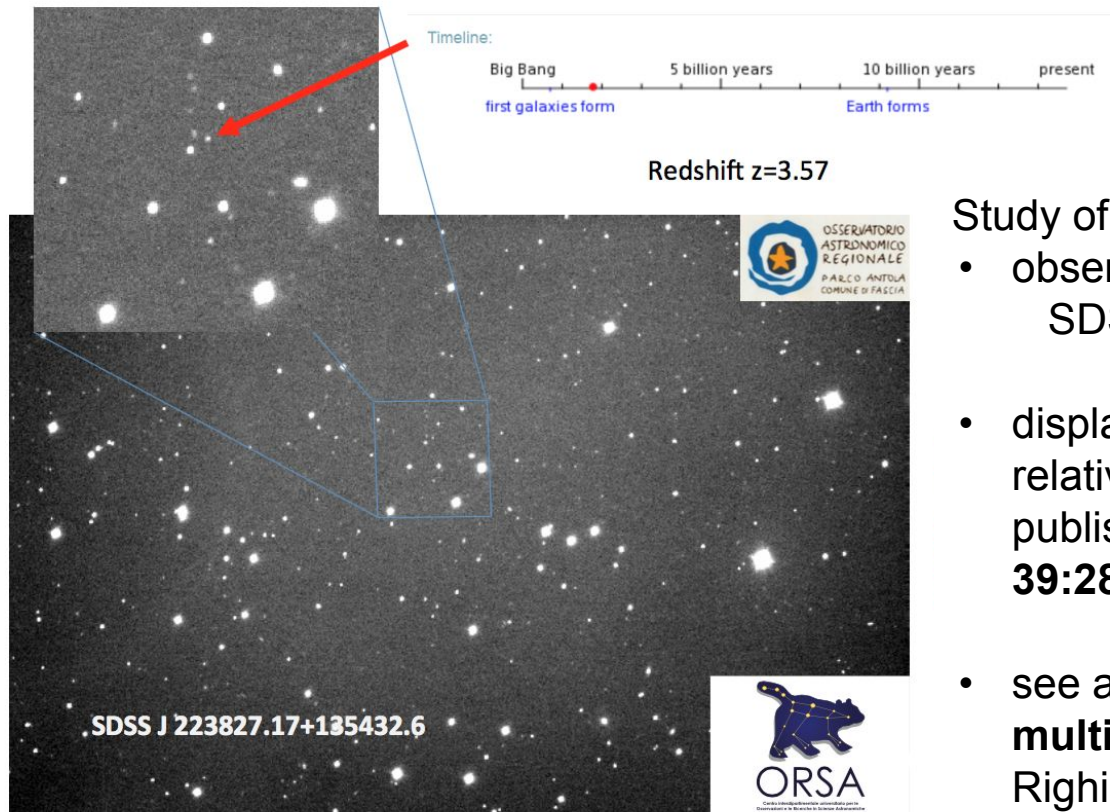
Multi-filter  
transit  
observations of  
HAT-P-3b and  
TrES-3b with  
multiple  
Northern  
Hemisphere  
telescopes.

**Ricci et al. PASP  
129, Number  
976, 2017**





# Blazar e Quasar



## Study of Blazars:

- observation of a BL Lac candidate:  
SDSS J223827.17+135432.6
- displayed at conferences and relative proceedings, with an article published (**Righi 2016 Nuovo Cim. 39:284, 2016**).
- see also “**L’astrofisica multimessenger da blazar.**”, Righi, this conference.

# Gravitationally lensed quasars

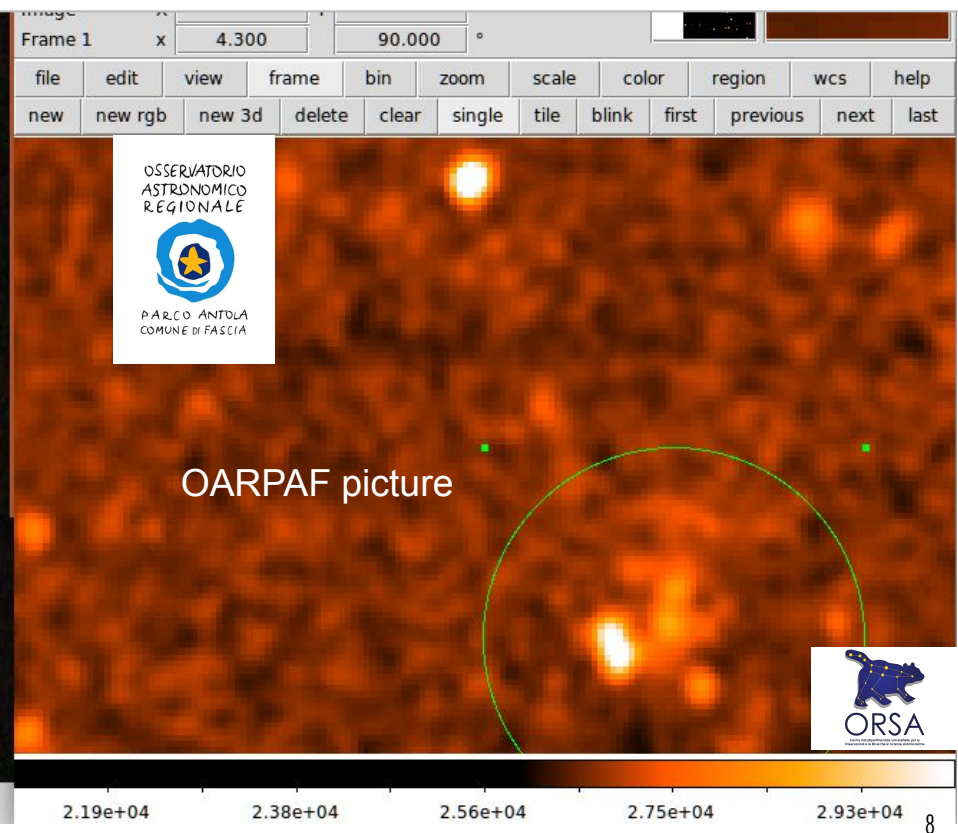
**SDSS 1004+41123**  
**4 multiple images**

HST picture



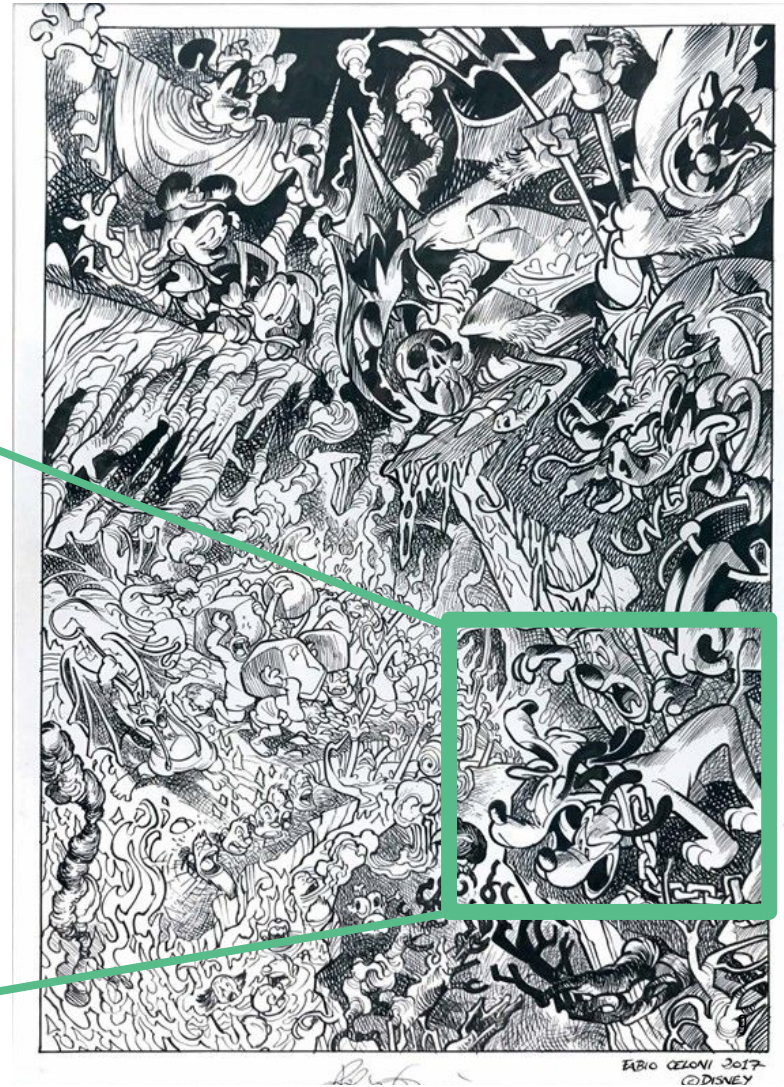
1366 × 768 pixel 1,1 MB 143%

4 / 4





A three-headed instrument:  
“Cerberus”

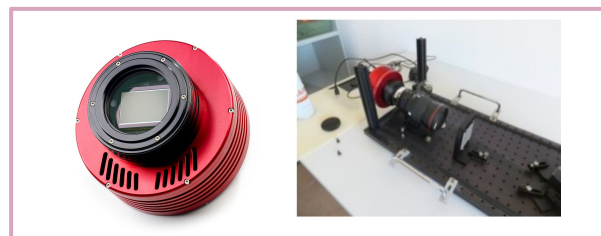




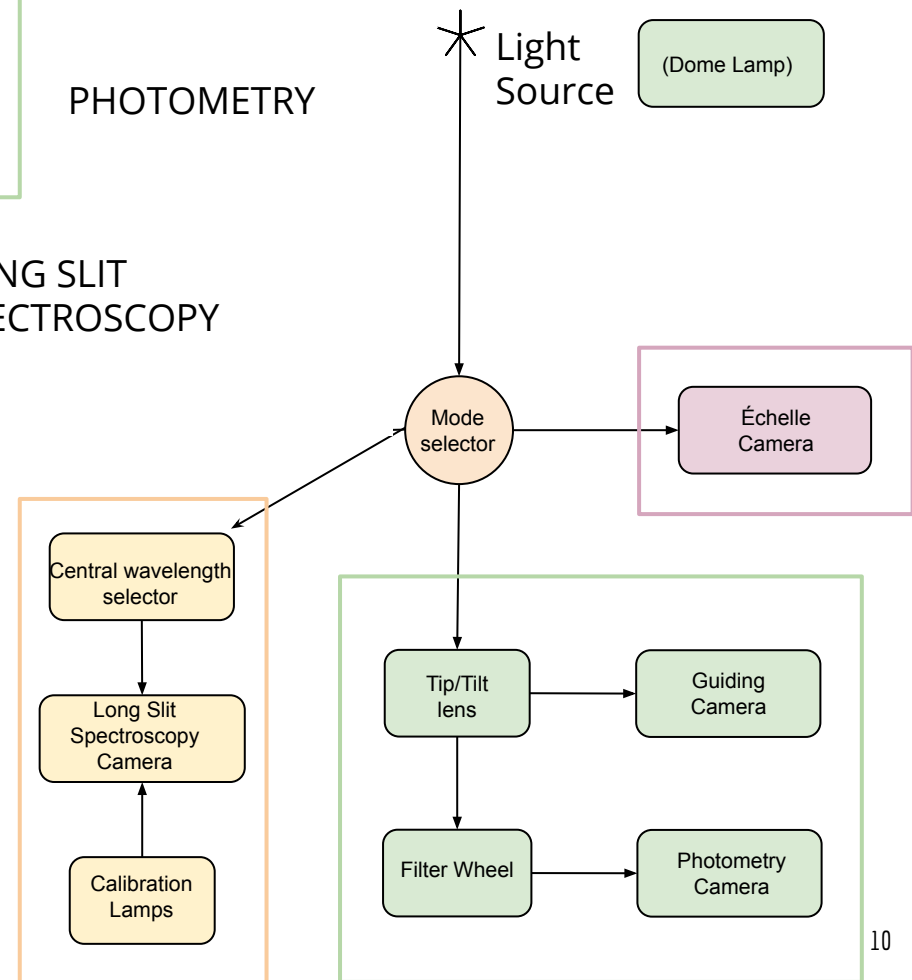
PHOTOMETRY



LONG SLIT SPECTROSCOPY



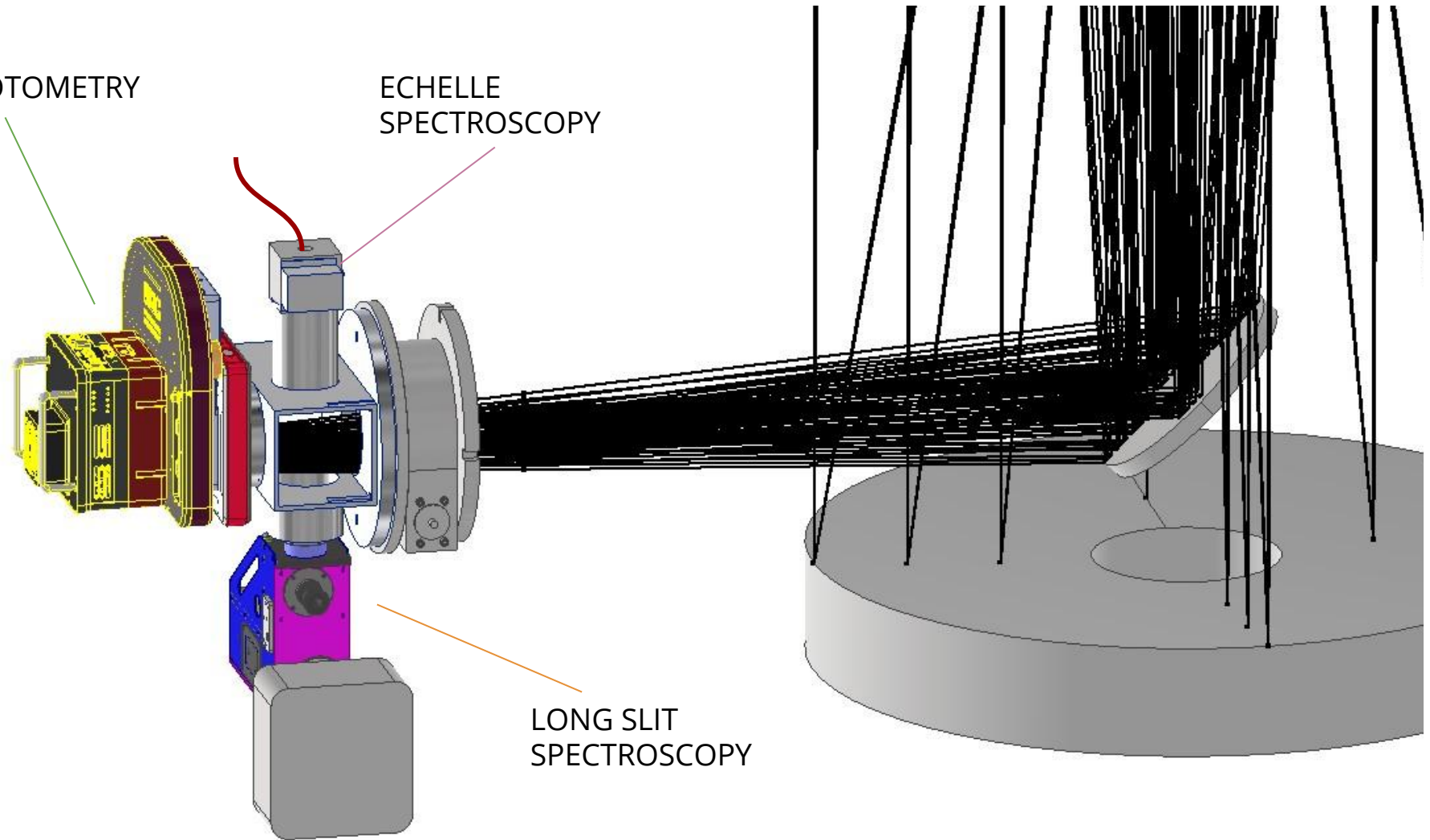
ECHELLE SPECTROSCOPY



PHOTOMETRY

ECHELLE  
SPECTROSCOPY

LONG SLIT  
SPECTROSCOPY





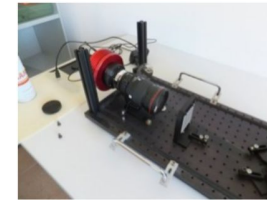
## PHOTOMETRY



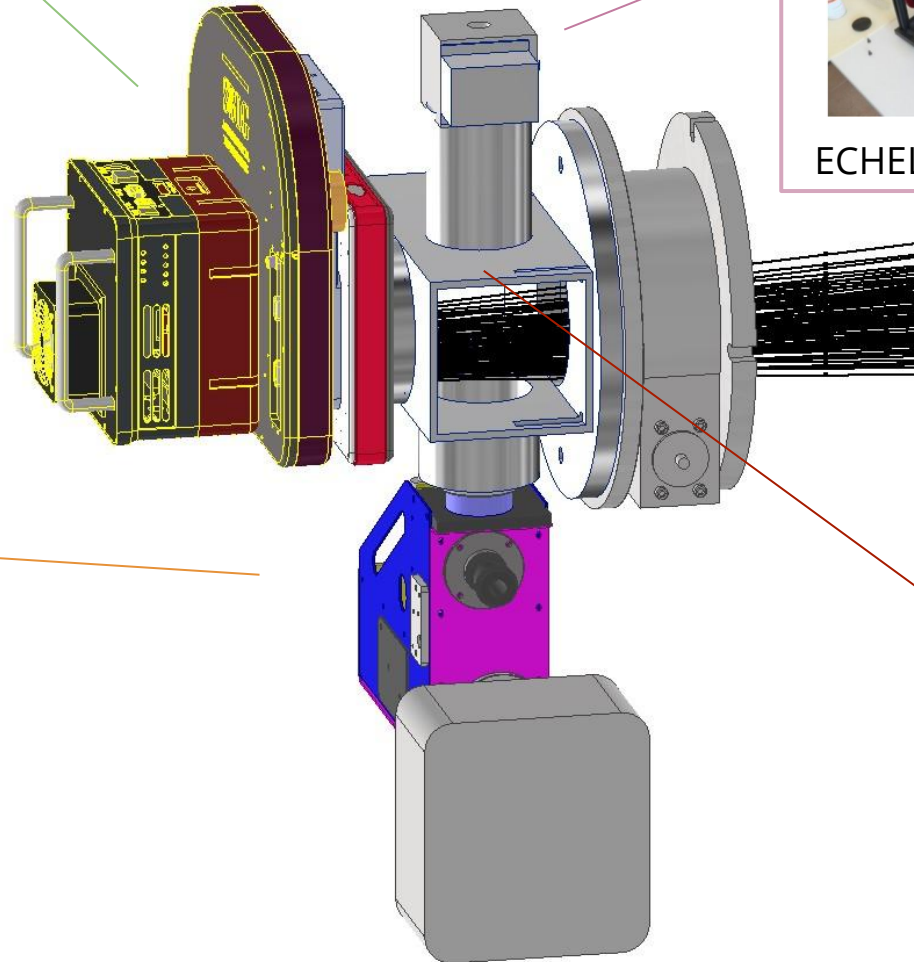
## LONG SLIT SPECTROSCOPY



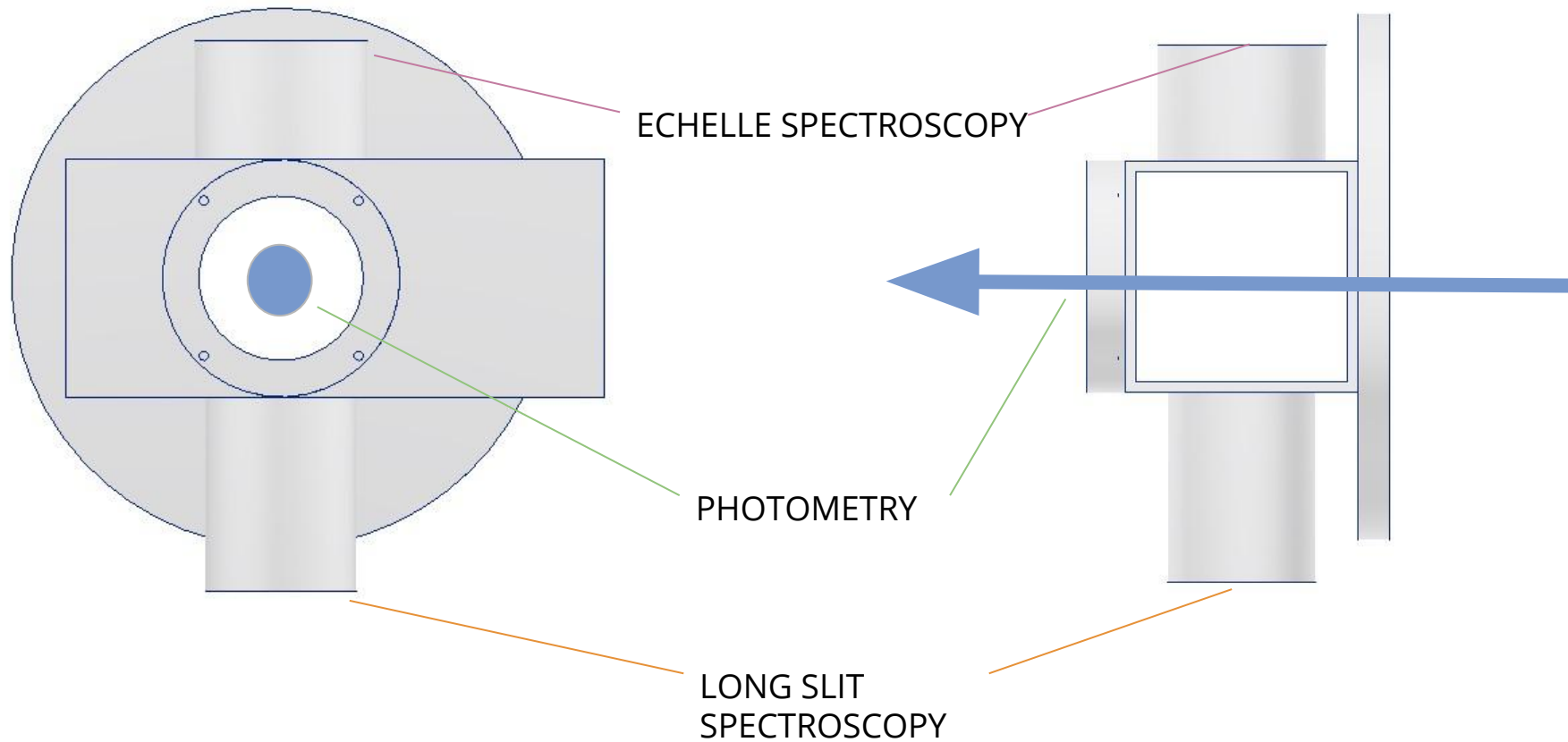
## ECHELLE SPECTROSCOPY



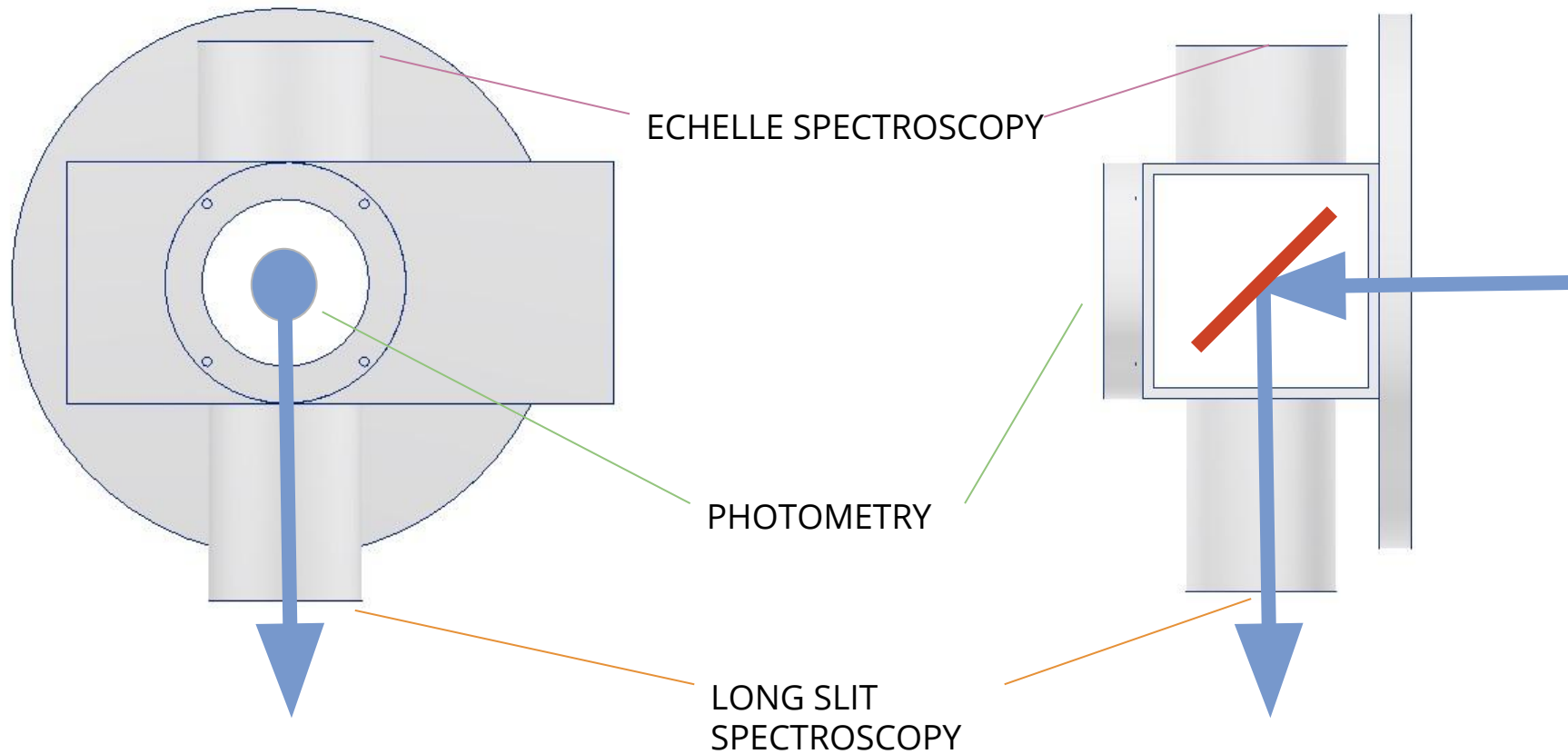
## INTERFACE FLANGE (MODE SELECTOR)



# Interface flange + mode selector

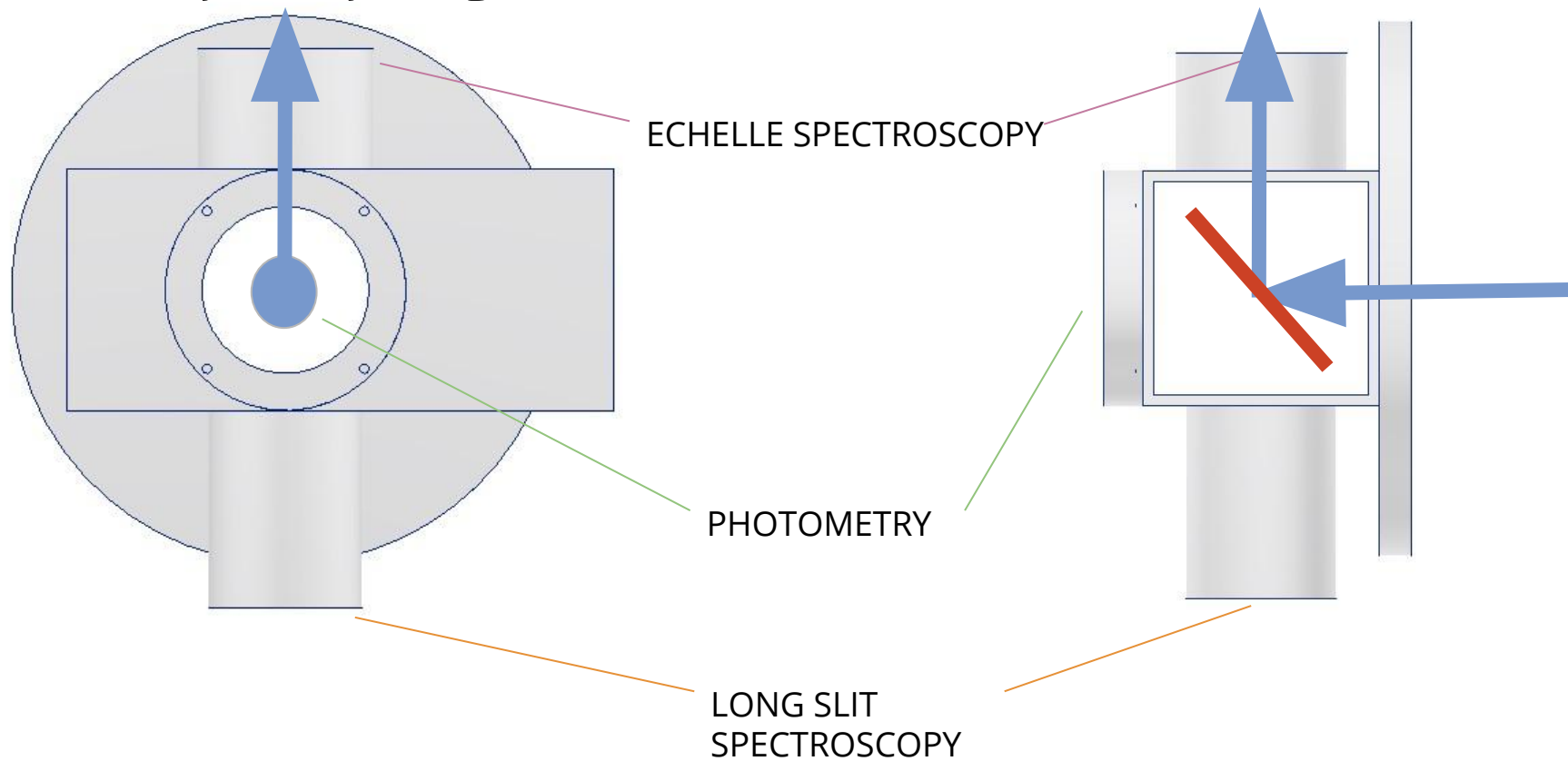


# Interface flange + mode selector



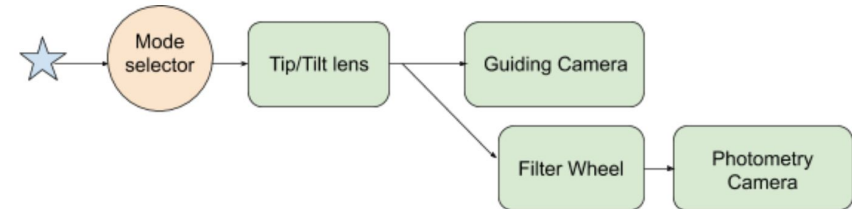


# Interface flange + mode selector



# Photometry

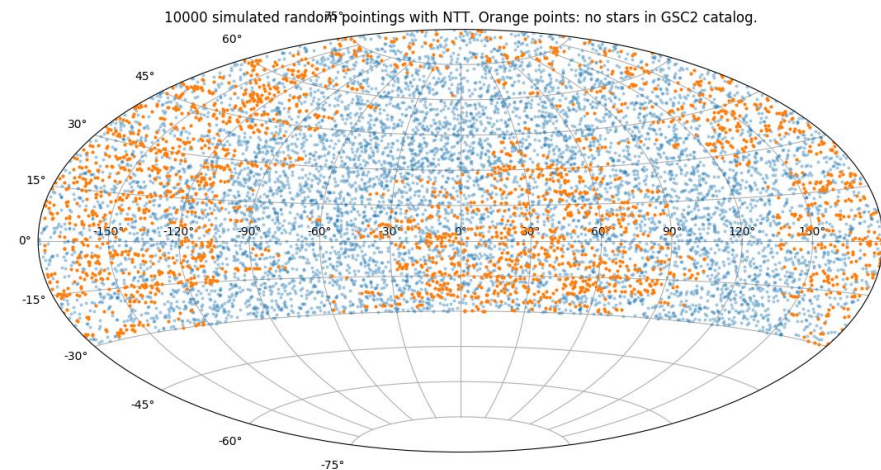
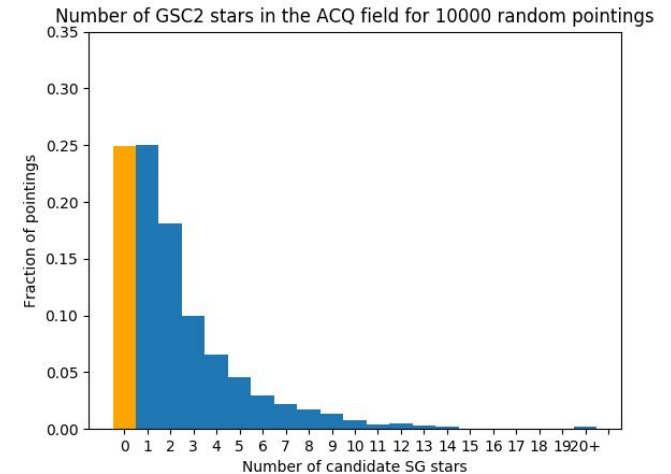
- CCD STX-16801
  - <http://diffractionlimited.com/product/stx-16801>  
4096×4096, 9μm pixel array CCD
- Filter wheel:
  - <http://diffractionlimited.com/product/fw7-stx>
- Integrated guide module in the filter wheel.
  - <http://diffractionlimited.com/product/stx-guider>
  - CCD 640x480 before the filter.
- Integrated Tip-Tilt corrector (10Hz, shift of a maximum of 16px on the CCD)
- Advantages:
  - Ethernet connection without buffer PC.
  - Guide CCD integrated and derotated for a possible correction of derotation errors
  - It works with node.
- Disadvantages:
  - Tip-tilting may be not performing at top in our case.



# Random Pointing: how many stars brighter than $V=13$ ?

- 10000 random pointing from OARPAF;
- Query in the [GSC-II](#) catalog:
  - 25% of the pointing has no star with a minimum magnitude of  $V=13$ ;
  - 25% of the pointing has at least one star with a minimum magnitude of  $V=13$ .
  - 50% of the pointing has more than one star with a minimum magnitude of  $V=13$
- OK using a guide star;
- OK using 1Hz tip tilt;
- BUT a Tip tilt a 10Hz is more difficult **under these conditions..**

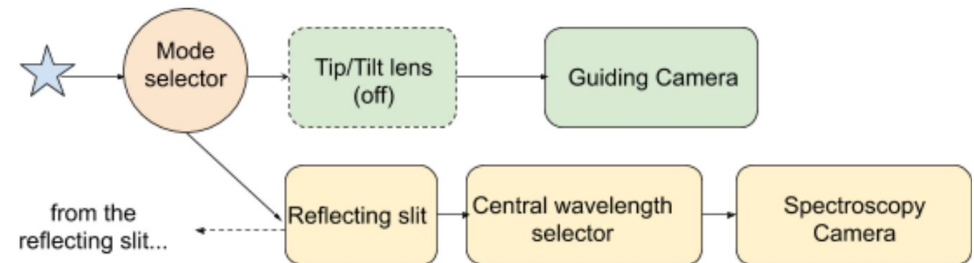
Limit to retrieve centroid of 3" seeing simulated star at 10Hz with  $<0.1''$  RMS accuracy





# Long Slit Spectrometer

## LHIRES III

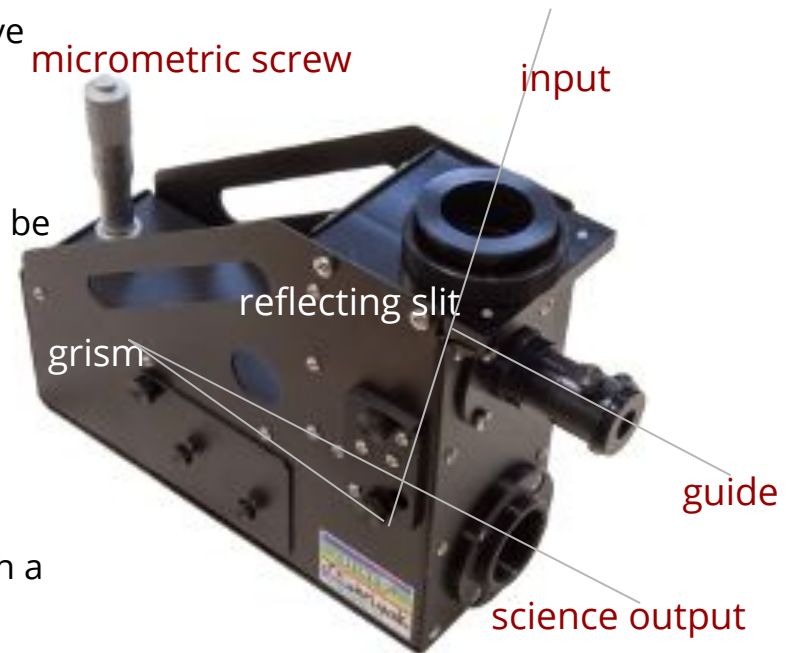


- Advantages:

- It is already working and it could be used with an operative CCD.
  - The SBIG STL has already the node software.
- "plug and play", could be separately tested.
- Whenever substituted with a superior instrument it could be used as high quality teaching gear.

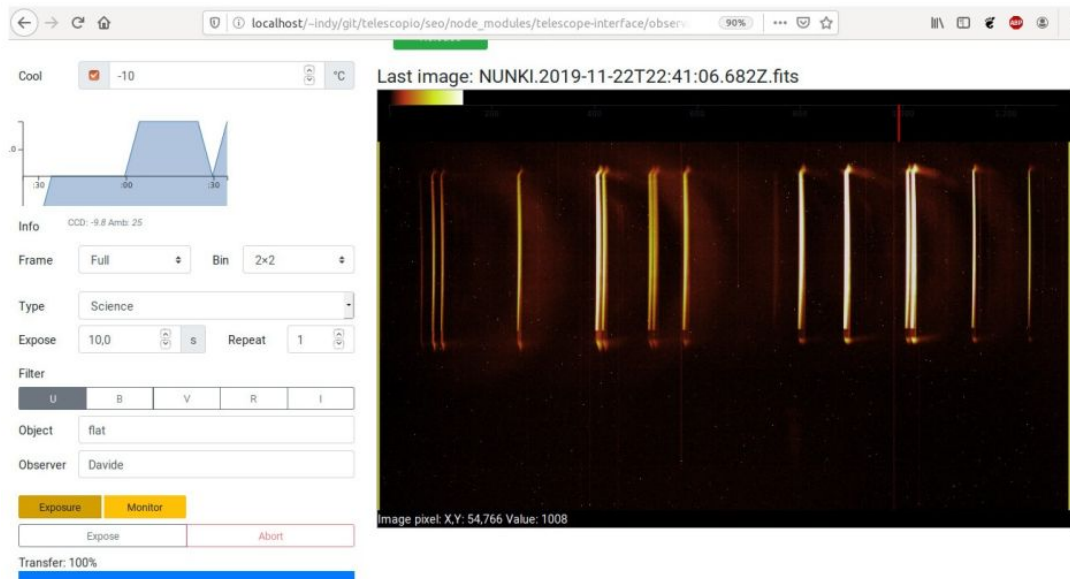
- Disadvantages:

- it could be used with success but still not a professional instrument;
- the doublet and the micrometric screw are still not motorized;
- The entirety of the spectral range cannot be obtained with a single acquisition.
- Slit e Grism manually inserted



# Further consideration on the long slit spectroscope

- The resolving power is  $R \sim 5900$  with the grid with 1200 lines per mm.
- For one hour of acquisition and a telescope 20cm wide the manual gives a limit in magnitude of 6.8 to obtain a **SNR of  $R=100$** .
- OARPAF is 80cm wide then it captures 16 times more light. So in the same conditions we have a **limit of magnitude of 10**.
- The field width of one acquisition is  $0.0345 \text{ nm/px} * 4000\text{px} = \mathbf{138\text{nm}}$ .
- Then with two exposures with two different positions of the micrometric screw it can be covered the entirety of the spectral range (300nm).



# Échelle spectrometer

The spectrometer is already commissioned and present at the observatory.

This mode requires a flat mirror to address the light on a 15m long optical fiber.

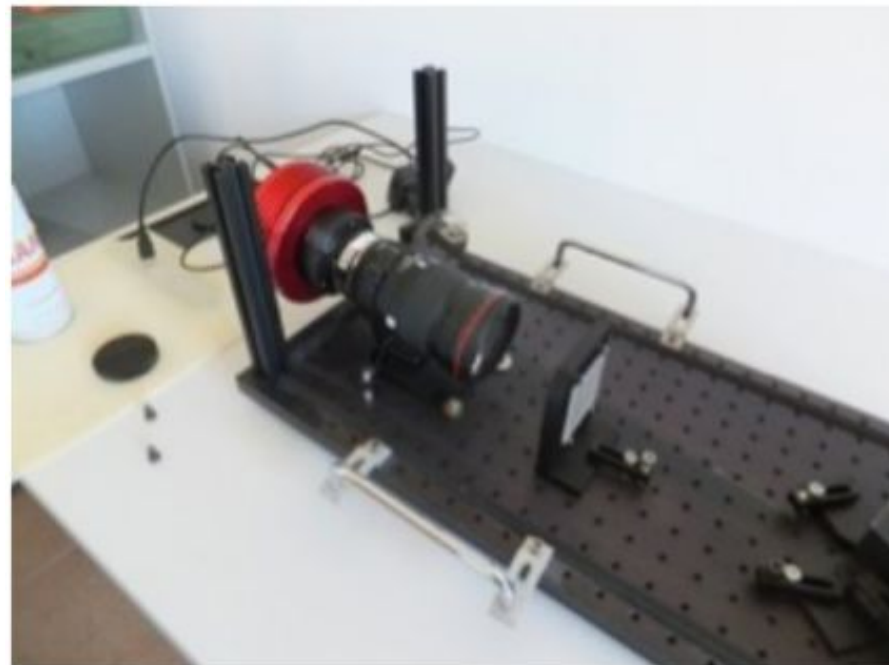
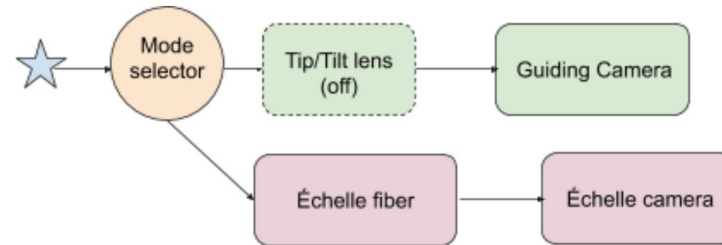
The part of the light that passes through the fiber is focused on a CCD camera on the Échelle spectrograph.

**A part of the light is required to proceed straight to the guiding camera on the imager.**

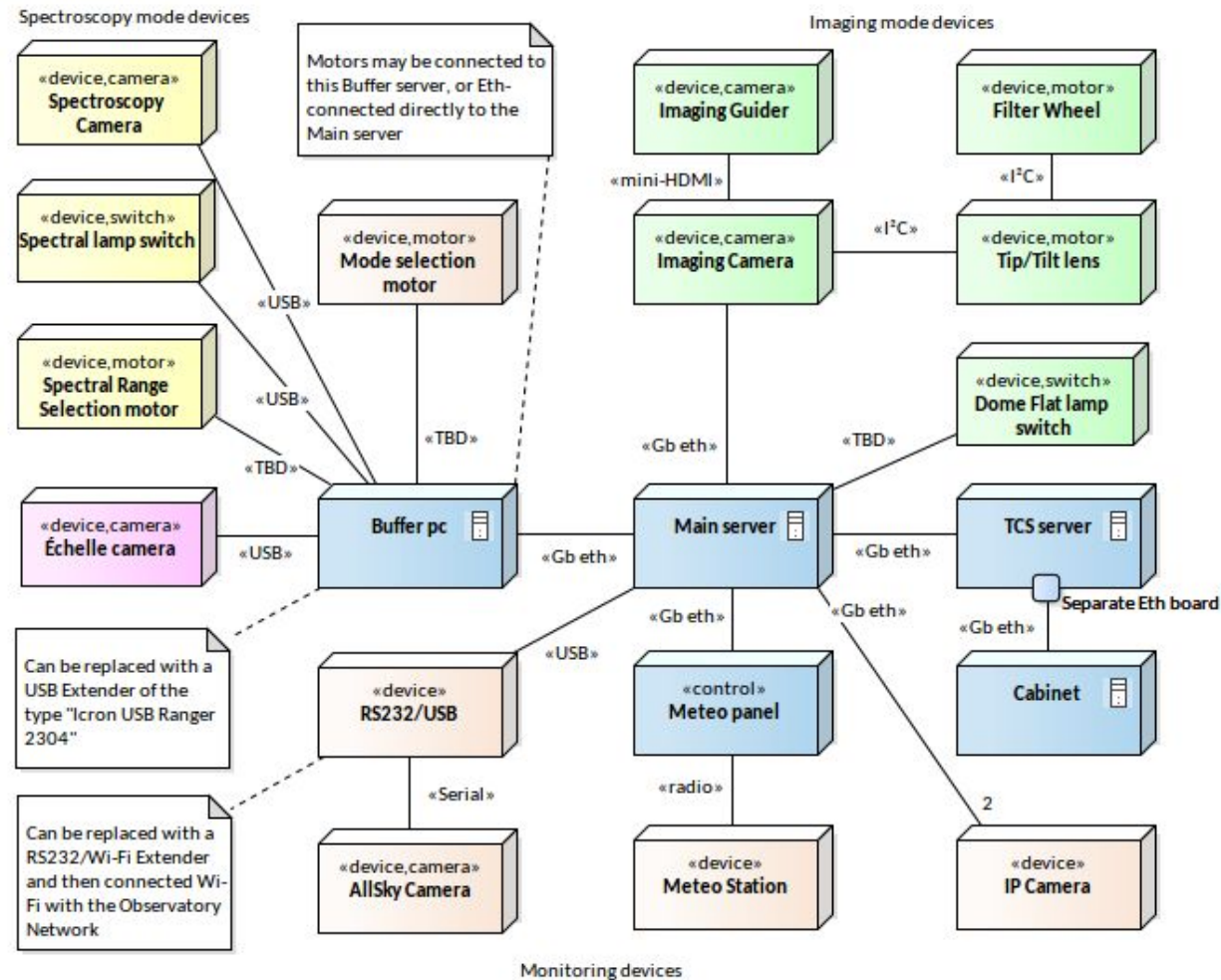


CCD: ATIK 11000

37×25mm, 4008×2672px



## PLANNED NETWORK LAYOUT







# Further prospects

1. A New dome has been installed by the Gambato company
2. 2020: ending of the maintenance works at the observatory;
3. 2020-2021 completion of the remotization of the observatory;
4. December 2020 displaying of the future status of Cerbero to the  
**SPIE Astronomical Telescopes + Instrumentation  
2020 Virtual (ex San Diego, ex Yokohama)**

END



THANK YOU FOR THE CONSIDERATION